1.1.1.1.1.10 Chapter 11

11. Visual Search Patterns

Almost all search and rescue missions are concluded by visual searches of the most probable areas once good information has been received from electronic searches, SARSATs, or other sources. This chapter will cover visual search patterns, some advantages and disadvantages of each, and some of the factors that help determine the type of search pattern you should use. The observer and mission pilot must carefully assess several important factors and their effects that go into the planning phase of a search operation.

11.1 Planning Search Patterns

Before missions are launched, the briefing officer provides pilots and crew members with information designating the routes to and from the search area, transit and area search altitudes, communications procedures, and the type(s) of search pattern to be used in the search area. Mission observers, who assist in navigation, must be familiar with each type of search pattern since each requires precise navigation and technique.

CAP aircrews use the GPS as its primary navigational and search pattern tool because of its versatility and accuracy. Dead reckoning is the least effective navigational method to aid aircrews in covering search areas adequately. If there are prominent landmarks in the area, aircrew members can use dead reckoning with some degree of effectiveness by taking frequent compass and drift readings. However, dead reckoning is not used since more accurate means of navigation are available.

Several types of visual search patterns are used in search and rescue. Many straight line “patterns” are simple while others are more complex. When flying each pattern, navigational accuracy directly affects search adequacy and the probability of detecting the objective.

The following discussions are directed primarily toward a single aircraft search, but the same general procedures apply when multiple aircraft are involved. The descriptions will cover track line, parallel, creeping line, square, and contour search patterns.

11.2 Route (track line) search

Search planners will normally use the route search pattern when an aircraft has disappeared without a trace. This search pattern is based on the assumption that the missing aircraft has crashed or made a forced landing on or near its intended track (route). It is also assumed that detection may be aided by survivor signals. Search planners often use the track line pattern for night searches in suitable weather. A search aircraft using the track line pattern flies a rapid route

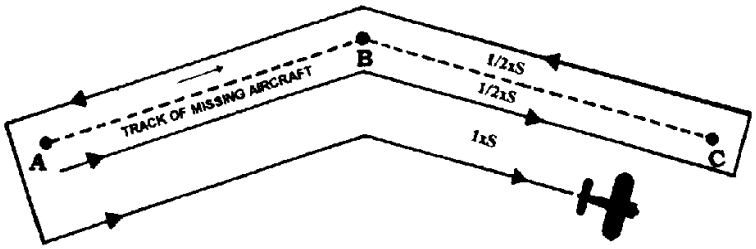

Figure 11-1

on either side of the missing aircraft's intended track. At the beginning point of a search, the aircraft begins with one-half search track spacing from the trackline.

Figure 11-1 illustrates the route (track line) search pattern. The search altitude for the track line pattern usually ranges from 1000 feet above ground level (AGL) to 2000 feet AGL for day searches, while night searches range from 2000 to 3000 feet AGL. Search altitudes are determined primarily by weather, light and visibility conditions. This pattern provides reasonably thorough coverage.

The search crew begins by flying parallel to the missing aircraft's intended course line, using the track spacing (labeled “S” in Figure 11-1) assigned during briefing. On the first pass, recommended spacing may be one-half that to be flown on successive passes. Search coverage is increased if you fly one-half “S” track spacing in the area where the search objective is most likely to be found.

11.3 Parallel track or parallel sweep

This procedure is used when one or more of the following conditions exist:

- the search area is large and fairly level.
- only the approximate location of the target is known.
- uniform coverage is desired.

Refer to Figure 11-2. The aircraft proceeds to a corner of the search area and flies at the assigned altitude, sweeping the area maintaining parallel tracks. The first track is at a distance equal to one-half the track spacing (½ x S) from the side of the area.

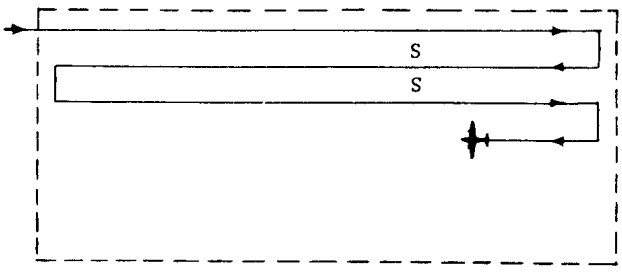

Figure 11-2

When more than one aircraft is available a variation of the parallel track search, the parallel sweep, can be used as shown in Figure 11-3. This sweep pattern is used when a search of a large area in a minimum amount of time is desired. However, a large number of aircraft are required to carry out this type of search. All aircraft report to the last reported position of the distressed unit before they go to their own "out" search tracks. Presuming that all search aircraft will

return to the search base, the initial track spacing assigned is (2 x S) for that particular search. There should be a distance of one 'S' between out and in tracks. If sufficient aircraft are not available to effect this type of search, it may be possible to use aircraft regularly traveling this route to assist.

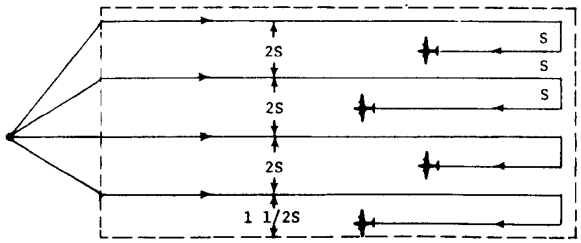

Figure 11-3

11.4 Creeping line search

The creeping line search pattern is similar to the parallel patterns. The parallel pattern search legs are aligned with the major, or longer, axis of the rectangular search areas, whereas the search legs of the creeping line pattern are aligned with the minor or shorter axis of rectangular search areas. Figure 11-4 shows the layout of this search pattern. Search planners use the creeping line pattern when:

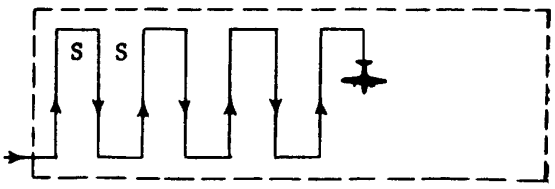

Figure 11-4

- The search area is narrow, long, and fairly level.
- The probable location of the target is thought to be on either side of the search track within two points.
- There is a need for immediate coverage of one end of the search area.

This coverage is followed immediately by rapid advancement of successive search legs along the line. Rectangular and elongated are the two forms of the creeping line pattern. For each form, the starting point is located (½ x S) inside the corner of the search area.

Successive long search legs use track spacing assigned by the incident commander or planner, while the short legs may be flown to within one-half that spacing of the search area's edge.

11.5 Expanding square search

Search planners rarely use the expanding square search pattern. It is designed for use when the search area is small and the position of the survivors is known within close limits (less than 20 square miles). This pattern requires precise navigation.

Usually the first leg is flown directly into the wind to minimize navigation errors. This pattern is referred to, at times, as the expanding square because it begins at an initially reported position and expands outward in concentric squares. If error is expected in locating the reported position, or if the target were moving, the square pattern may be modified to an expanding rectangle with the longer legs running in the direction of the target's reported, or probable, movement.

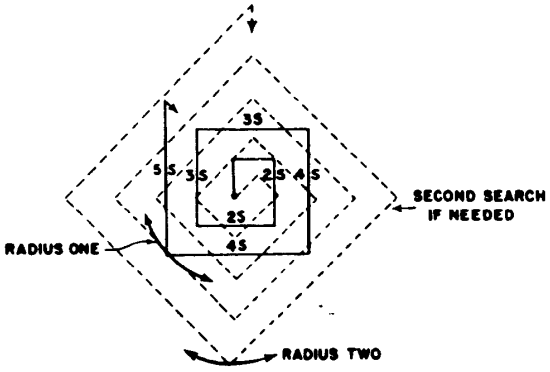

Figure 11-5

To minimize navigational errors due to wind drift, the first leg may be flown directly into or directly with the wind. Every other leg will thus be affected by cross wind that might blow the search aircraft off course.

In light or no wind conditions, it's often helpful to orient the expanding square pattern along the cardinal headings, that is, a direct northbound leg, followed by eastbound, then southbound and westbound legs. Length and width of the pattern may be modified to suit the requirements and conditions of the individual search.

If the results of the first expanding square search are negative, and the pattern must be flown a second time over the same area, it's helpful to skew the pattern 45° to the initial orientation. This increases the likelihood of locating an objective already once missed. The second search should begin at the same starting point as the first did, but the first leg of the second search is flown diagonally to the first leg of the first search. The entire second search pattern will diagonally overlie the first.

The bold, unbroken line in Figure 11-5 illustrates the first search and the dashed line represents the second. Track spacing is "cumulative," showing the total width of the search pattern at a given point on that leg. Actual distance on a given leg from the preceding leg on the same side of the pattern is still only one ‘S’. The second search of the area should begin at the same point as the first search.

11.6 Sector search

The sector search is another visual search pattern that can be used after the approximate location of the target is known. This pattern should be planned on the ground because it involves multiple headings and precise leg lengths. The pilot will fly over the suspected location and out far enough to make a turn, fly a leg that is equal to the maximum track spacing, then turn back to fly over the point again. This pattern continues until the point has been crossed from all the angles as shown in Figure 11-6.

The sector search has several advantages:

- it provides concentrated coverage near the center of the search area.
- it is easier to fly than the expanding square pattern.
- it provides the opportunity to view the suspected area from many angles, so terrain and lighting problems can be minimized.

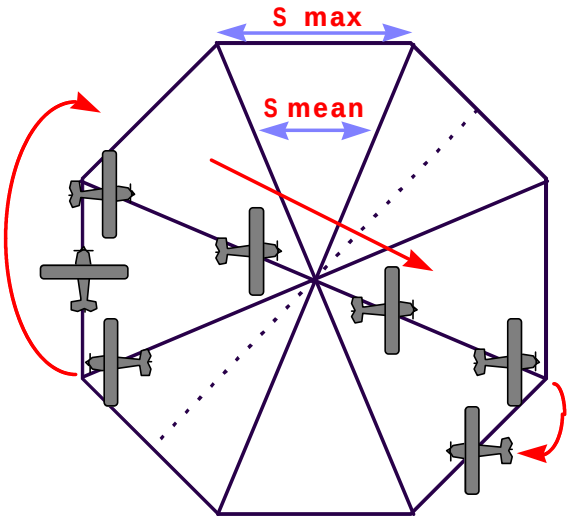

Figure 11-6

11.7 Contour search

The contour search pattern is best adapted to searches over mountainous or hilly terrain Depending upon the terrain, the search begins above the highest peak and continuously spirals downward, with each consecutive circuit usually flown 500 feet lower. While descending to a lower altitude, the pilot turns the aircraft 360 degrees in the direction opposite to the search pattern. As an alternative, the search may be flown the length of a ridge, reversing direction and descending at either end. Both options are depicted in Figure 11-7.

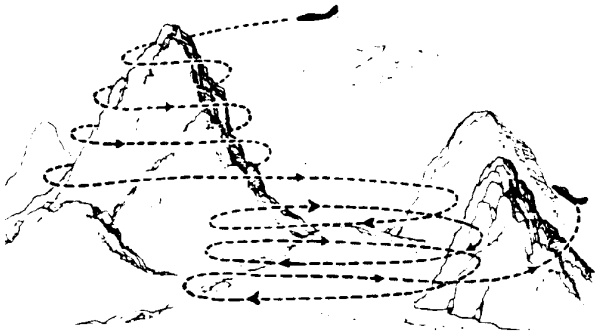

Figure 11-7

As you may have already gathered, the contour search pattern can be dangerous (see Chapter 9). The following are some helpful measures to be keep in mind before and during a contour search:

- The crew should be experienced in flying contour searches, well briefed on the mission procedures, and have accurate, large scale maps indicating the contour lines of the terrain. The pilot must be qualified and current in CAP mountain flying.
- Weather conditions should be good with respect to visibility.
- Wind gusts should be minimal to nonexistent.
- The search aircraft should be maneuverable with a steep climbing rate (i.e., high-powered aircraft) and capable of making small turning circles.
- The search should be started above the highest peak of the terrain.

Valleys and canyons also pose problems during contour searches. The search crew should highlight or mark all features that pose possible hazards to contour searching. If any crew member senses that further flight may put the search airplane in a situation where it can neither turn around nor climb out of a valley or canyon, the aircraft must not proceed any further. Crewmembers must also stay alert for wires and power lines that may cross a canyon or valley significantly above its floor. If required to fly through canyons, fly *down* the canyon so that the canyon mouth provides a safe way out. The crew should always exercise extreme caution, mark hazards or problem areas on the chart, and report them to the mission planner or debriefing officer.

As an observer on a contour search mission, you should keep an accurate record of the areas searched. Since some areas will be shrouded in fog or clouds, you will have to search those areas when weather conditions permit. One method of making such a record is to shade areas on the chart as each area is searched, as illustrated in Figure 11-8. The areas that are not shaded are those areas that cannot or have not been searched, and must be searched when conditions permit.

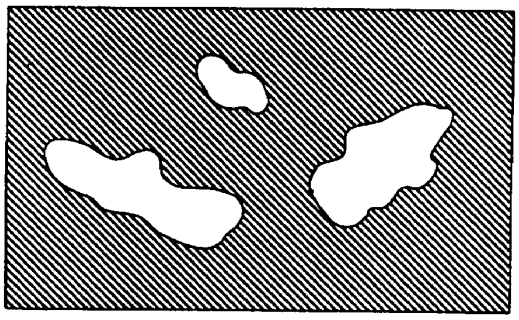

Figure 11-8

11.8 Using the GPS to fly search patterns

The GPS and LORAN were introduced in Chapter 7. This section will examine GPS features (LORAN features are very similar), and discuss ways to use them while flying search patterns.

Methods of building flight plans, identifying points, and entering and retrieving information vary by model and manufacturer, and this discussion will be limited to the most general features. The operating handbook for each GPS should be studied thoroughly for similarities to and differences from the discussion to follow.

Here's some basic terminology:

Cross track - This is the number of nautical miles left or right of a course programmed into the GPS. Some manufacturers call this *track error.*

Distance to go - The number of miles remaining to the next turn point in the programmed sequence.

Waypoints - Designations for the departure point, destination, and all intermediate or turn points for a given route when storing them in GPS memory.

Imagine you are assigned to fly the track crawl from Point A to Point B in Figure 11-1. The planner has selected two-mile track spacing for the search. You can store the two points' lat/long coordinates as user-defined waypoints in the GPS database (e.g., RCS01 to RCS02). If you select a course of "RCS01 to RCS02," the GPS will display the direct course (heading) from Point A to Point B and the CDI will show how many nautical miles the aircraft is left or right of course. If you're on course, you can turn slightly right, away from the course, until the GPS shows one mile right and then return to the planned heading (no wind), deliberately but accurately flying the leg one mile "off course." Remember that on the route search the first pass is at one-half the track spacing of the passes that will follow. If another pass is needed on the opposite side of the track, reverse the waypoint order so that the GPS will display data for the return course (RCS02 to RCS01). You can then fly one mile "off course" on the opposite side while going in the opposite direction. If a third leg is necessary, reverse the points again, and add two miles to the deliberate "off-course" distance. The next leg is then three miles right of the direct course.

It will be the pilot's job to maintain the desired "off-course" distance. Just like when keeping the DF or VOR needles centered, he will make only very slight course corrections to keep the aircraft at the desired "off course" spacing.

If the search has been narrowed, the crew may be assigned to search an area using a parallel track pattern. You sketch the search area on your sectional and then draw two points along one edge at either end of the box. Once you enter the lat/long coordinates of the two points as waypoints, you will be able to accurately fly the first leg along the edge of the area. When the distance remaining reaches zero, the aircraft is at the end of the box. Confirm this by reading the chart and reverse or re-sequence the waypoints while turning around. Again, deliberately navigate "off course" at the briefed track spacing back to the opposite end of the box. Continue this exercise across the full width of the search box. This or similar techniques can be adapted to the creeping line and expanding square patterns as well.

Another very handy feature of the GPS is its ability to display your aircraft's present position in terms of latitude and longitude. Using this display, you can "fly" a particular latitude or longitude with great precision. For instance, if you have to fly a grid you just note the lat/long boundaries of the grid and fly it using present position. Present position can be used to fly almost any pattern.

If you devote an excessive amount of time "inside" with programming and switching during the search, you might miss an important visual contact or clue "outside." In fact, a feature of the GPS helps you avoid looking "inside" too much when you want to mark a sighting. All GPS units have a single button that, when pressed, stores the lat/long of the aircraft's position as a temporary waypoint. However, you must remember that the aircraft's position and the object you want to mark are not the same; you must note the direction and distance from the airplane to the target (e.g., one mile to the northeast) for greatest accuracy.